REMARKS/ARGUMENTS

Claim Status

Claims 1, 3-7 and 9-11 are pending. Claim 1 is currently amended to clarify that the light emitting *apparatus*, not the light emitting *device*, comprises the via holes. Applicants submit that the amendment to claim 1 is supported by Figure 1 and its corresponding description of the via holes (15) on page 11, lines 1-10. No new matter is believed to have been entered.

§112, 1st paragraph, Rejection

Claims 1, 3-7 and 9-11 are rejected for failing to comply with the written description requirement because "there is no support in the specification for the claim limitations of 'the co-fired aluminum nitride substrate has a thickness of 0.3 to 0.6 mm' as recited in claim 1." Applicants respectfully traverse this rejection.

Applicants submit that the claimed thickness range of the substrate is supported by the Examples of the specification for at least the following reasons. MPEP §2163.05 and in *In re Wertheim* (191 USPQ 90 (CCPA 1976)) state:

> "With respect to changing numerical range limitations, the analysis must take into account which ranges one skilled in the art would consider inherently supported by the discussion in the original disclosure."

Accordingly, Applicants submit that one skilled in the art of LEDs would consider Applicants in possession of the exemplary substrate thickness values *as well as* the values there-between. Furthermore, Applicants point out that, just as there is no requirement that a range of a particular value be supported by examples covering every data point between the endpoints, there is no rule that requires *express* support for a value range when that range is clearly discernable from the numerous examples. Thus, as the claimed thickness range of the substrate is clearly discernable from the examples of the specification and those skilled in the

art would consider Applicants in possession of such a range, Applicants submit that the claimed range at issue satisfies the written description requirement. As such, Applicants request withdrawal of this rejection.

§112, 2nd paragraph, Rejection

Claims 1, 3-7 and 9-11 are rejected for being "unclear as how the via holes can penetrate the co-fired aluminum nitride substrate from the front surface to the rear surface when the via holes of the light emitting device are arranged on the front surface of the co-fired aluminum nitride substrate." Applicants traverse this rejection.

As noted above, claim 1 has been amended to clarify that the light emitting *apparatus*, not the light emitting *device*, comprises the via holes, as shown in Figure 1 and described on page 11 of the specification. In light of this clarification, Applicants submit that this rejection has been overcome. Thus, Applicants request withdrawal of this rejection.

§103(a) Rejections

Claims 1, 4, 5, 8 and 9-11 are rejected as obvious in view of *Hsing Chen* (US 2004/0188696), *Hikasa* (US 5,770,821) and *Lee* (US 2004/0262738). Claim 3 is rejected as obvious in view of *Hsing Chen*, *Hikasa*, *Lee* and *Nakabayashi* (US 2002/0167017). Claims 6 and 7 are rejected as obvious in view of *Hsing Chen*, *Hikasa*, *Lee* and *Arai* (US 4,220,810). Applicants respectfully traverse these rejections.

A. Claimed Invention

The claimed invention relates to an apparatus that emits white light, wherein the apparatus has a particular structure such that the reflection efficiency and luminous efficiency of the emitted white light is improved by controlling (i) the surface roughness of the co-fired aluminum nitride substrate, (ii) the materials that make up the vapor-deposited film (i.e., Ag

or Al), (iii) the thickness of the vapor-deposited film and (iv) the thickness of the co-fired aluminum nitride substrate.

Furthermore, the Ag or Al metal film of the claimed apparatus, which is formed on the LED-mounting surface of the AlN substrate and has a reflectivity of 90% or more, is used as the reflection film. Accordingly, since said metal film is used as the reflection film of the claimed apparatus, **a reflector is not needed**. In view of the lack of need for an additional component/reflector in the present invention, and in view of the **lack of wire-bonding** (see claim 1 and response filed February 13, 2009), the thickness of the claimed apparatus can be suppressed thereby allowing for the production of a **thin-type light emitting apparatus that has a compact size and reduced thickness**. However, it should be noted that the claimed apparatus, while having a reduced thickness, maintains a sufficient insulating property and mechanical strength (see further discussion below).

B. *Hsing Chen*

The newly cited *Hsing Chen* reference discloses surface mount LED packages comprising LED dies, sub-mount wafers and via arrays (Abstract). The Office asserts that *Hsing Chen* discloses a LED apparatus comprising an aluminum nitride substrate (1010), a LED (1024) arranged on a front surface (1016) of the aluminum nitride substrate (1010), wherein the LED (1024) comprises a vapor-deposited metal film (1082) and via holes (1014), and the "vapor-deposited metal film [(1082)] being arranged on the front surface of the substrate [(1010)]" (sentence bridging page 3-4 of Office Action). This assertion is incorrect.

Hsing Chen does not disclose a vapor-deposited metal film **being arranged on the front surface of the aluminum nitride substrate** as claimed by Applicants. Instead, *Hsing Chen* discloses reflector cavities/cups (1080) formed on the front surface of the substrate via cavity wafers (1078), wherein the cavity wafers (1078) form the slanted sides of the cavities (1080) and "a reflective material is applied to the front-side of the cavity wafer (1078) to

form reflective layers (1082) on the slanted sides of the cavities (1080) that define the reflector cups" (see [0060] and Figure 12). Accordingly, *Hsing Chen* does not disclose, or depict in the Figures, reflective material applied to the front surface of the aluminum nitride substrate.

In addition, not only is the reflective material applied to a surface other than the front surface of the aluminum nitride substrate, but the reflective material is applied to a surface that protrudes outwardly from the surface of the substrate, thus **increasing the effective thickness of the apparatus** (i.e., substrate plus reflector).

In contrast, **the thickness of the claimed apparatus is suppressed** (thereby allowing for the production of a thin-type light emitting apparatus that has a compact size and reduced thickness) due to the claimed limitations that **the metal film has a thickness of 1-5 μm** and is formed directly on the front surface of **the aluminum nitride substrate which is 0.3-0.6 mm thick** (see claim 1).

Accordingly, not only does *Hsing Chen* fail to disclose or suggest a vapor-deposited metal film being arranged on the front surface of the aluminum nitride substrate as claimed by Applicants, but *Hsing Chen* also fails to disclose or suggest a LED apparatus as thin and compact as that claimed.

B. *Hisaka*

Now considering the again cited *Hisaka* reference, Applicants offer the following remarks. *Hisaka* is silent with respect to a vapor-deposited metal film being arranged on the front surface of the co-fired aluminum nitride substrate as claimed by Applicants. Furthermore, the mirror-polished substrate of *Hisaka* that the Office relies upon for its disclosure of a surface roughness of 0.02 μm Ra is noted as having a thickness of 0.2 mm (see col. 8, line 55). Such a substrate thickness as disclosed by *Hisaka* (i.e., 0.2 mm) is (i) not

within Applicants' claimed range of 0.3-0.6 mm and (ii) would not have sufficient insulating properties or mechanical strength.

In contrast, the use of an aluminum nitride substrate having a high thermal conductivity and a thickness of 0.3-0.6 mm as claimed, allows for the claimed LED apparatus to have "improved heat radiation performance and can thereby have significantly increased critical currents (maximum passable current, or applicable maximum current quantity) and dramatically increased emission intensities" while maintaining a sufficient insulating property and mechanical strength (specification: page 13, lines 1-4).

In addition, Applicants again note (see response filed February 13, 2009) that *Hisaka* is also silent with respect to the following claimed feature: the emission of white light. Therefore, not only is *Hisaka* silent about the particular emission of white light, but by default *Hisaka's* silence renders non-obvious the following determinations to obtain the claimed apparatus: (1) the desired surface roughness of the aluminum nitride substrate for increasing the emission intensity of the white light, (2) the desired material that makes up the vapor-deposited metal film for effectively reflecting the white light toward the front side of the substrate, (3) the desired thickness of the vapor-deposited metal film for effectively increasing the luminous efficiency of the white light, and (4) the desired thickness of the co-fired aluminum nitride substrate for effectively increasing the heat radiation performance and critical current quantity while maintaining sufficient insulating properties and mechanical strength.

Accordingly, *Hisaka* fails to disclose or suggest (a) a vapor-deposited metal film being arranged on the front surface of the aluminum nitride substrate as claimed by Applicants, and/or (b) a LED apparatus as thin and compact, and as insulating and strong as that claimed.

C. *Lee*

With respect to the newly cited *Lee* reference, Applicants note that *Lee* fails to disclose a thickness of an aluminum nitride substrate or a thickness of an Al or Ag metal film, despite the Office's allegations to the contrary. Applicants further note that this lack of disclosure by *Lee* is further supported by the Office's failure to provide a single citation to page or paragraph for any of the Office's allegation.

Moreover, *Lee* discloses that "the material of substrate 110 is a thermally-conductive ceramic such as alumina or beryllia," alumina being Al_2O_3 and beryllia being BeO (see [0021]). Accordingly, ***Lee* does not disclose an AlN substrate** as claimed by Applicants.

What's more is that the Office points to claim 4 of *Lee* for support for the allegation that "Lee et al. teach the vapor-deposited metal film having a reflectivity of 90% or more with respect to light emitted from the light emitting device; wherein the vapor-deposited metal film comprises aluminum or silver." This correlation by the Office between claim 4 of *Lee* and the claimed vapor-deposited metal film, used in the present invention to reflect light, is flawed. Claim 4 of *Lee* lists Cu, Ag, Au, Ni and W as potential materials for the "mounting pad and the connecting pad." These materials of *Lee* are selected for high electrical conductivity purposes as they are to be used in the mounting and connection pads, such materials are not selected for their light reflectivity properties. Furthermore, it should be noted that Cu, as well as the other materials exhibiting a deep color tone listed by *Lee*, are **not used as light reflecting materials in the present invention** as they would not exhibit the necessary light reflection properties. Accordingly, the mounting and connection pads of *Lee* are not equivalent to the claimed reflection film, and as such, Applicants submit that *Lee* is nothing more than an example of a conventional device having a conventional voluminous reflector.

In contrast, the Ag or Al metal film of the claimed apparatus, which is formed on the LED-mounting surface of the AlN substrate and has a reflectivity of 90% or more, is used as the reflection film. Accordingly, since said metal film is used as the reflection film of the claimed apparatus, **a reflector is not needed**.

Furthermore, the device of *Lee* has bonding wires 254 and 255 which extend between a bonding pad located on the top major surface of the semiconductor die 250 and the bonding pad 132 (see Figures 2A, 2B and 6B-6D).

In contrast, and as described above, the claimed invention **lacks wire-bonding** (see claim 1 and response filed February 13, 2009), and therefore the thickness of the claimed apparatus can be suppressed (e.g., the metal film has a thickness of 1-5 μm and the aluminum nitride substrate has a thickness of 0.3-0.6 mm), thereby allowing for the production of a **thin-type light emitting apparatus that has a compact size and reduced thickness**. Such compact size and reduced thickness would not be obtainable by *Lee* which uses bonding wires that protrude in a thickness direction.

Accordingly, not only does *Lee* fail to disclose or suggest a thickness of the substrate, a thickness of an Al or Ag metal film, an AlN substrate, a lack of a conventional voluminous reflector and/or a lack of wire-bonding, but *Lee* also fails to disclose or suggest a LED apparatus as thin and compact as that claimed.

D. Combination of all Cited References

Lastly, *Nakabayashi* and *Arai* are merely relied upon by the Office for their alleged disclosure of certain content of some of the dependent claims. As neither of these references fulfill the deficiencies of *Hsing Chen*, *Hikasa* and/or *Lee*, and as these three references share the same deficiencies (namely failure to disclose or suggest (a) a vapor-deposited metal film being arranged on the front surface of the aluminum nitride substrate and (b) a LED apparatus as thin and compact, and as insulating and strong, as that claimed), no combination

of the cited references render obvious the claimed invention - wherein the claimed invention eliminates the necessity of connection of the interconnections on the front surface of the substrate by a wire-bonding process, simplifies the interconnection structure, avoids the protrusion of bonding wires and reflectors in a thickness direction of the light emitting apparatus, so that a light emitting apparatus having a thin-shape and a compact size in the thickness direction can be provided. Accordingly, Applicants request withdrawal of the obviousness rejections of record.

Conclusion

Applicants submit that all now-pending claims are in condition for allowance. Applicants respectfully request the withdrawal of the rejections and passage of this case to issue.

Respectfully submitted,

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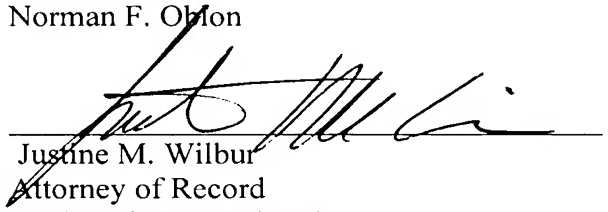

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